The New York Times

MATTER

'Lifeboats' Amid the World's Wildfires

Islands of greenery, called refugia, survive even the worst fires, sheltering species and renewing charred landscapes.

By Carl Zimmer

Oct. 12, 2018

Forests have burned in spectacular fashion this year. From California to Colorado, Portugal to Greece, photographers have captured terrifying images of infernos soaring into the sky and spreading to the horizon.

The fires left scenes of ashen destruction, but they did not wipe out everything. Scattered about the ravaged landscapes were islands of trees, shrubs and grass that survived unharmed.

It's easy to overlook these remnants, which ecologists call fire refugia. But they can be vital to the long-term well-being of forests. These havens shelter species that are vulnerable to fires. Afterward, they can be starting points for the ecosystem's regeneration.

"Those trees are lifeboats," said Meg Krawchuk, a fire ecologist at Oregon State University.

Writing recently in the journal BioScience, Dr. Krawchuk and her colleagues argued that it's urgent to better understand fire refugia, because they may be seriously threatened in future decades by climate change. Without them, many species may become threatened and the surrounding ecosystems may take longer to recover from wildfires.

Over the years, ecologists have called fire refugia by many names: fire shadows, unburned islands, skips, stringers. But only in the 1990s did the scientists start to pay serious attention to the ecological role that fire refugia play in forests and grasslands.

In the Pacific Northwest, for example, fires burn through forests every year, yet some fire refugia remain unharmed for centuries. Trees that are vulnerable to fire, such as Western hemlock and Pacific silver fir, thrive in these shady sanctuaries. And these trees shelter animals, such as the northern spotted owl, that struggle to survive in fire-prone forests.

These untouched islands may be essential even for species that normally live outside them. As the fire burns, animals seek shelter inside refugia. As the forest slowly regenerates, they can return to refugia for food or nesting.

Refugia in April 2015, after the Big Cougar Fire near Lewiston, Idaho. Arjan Meddens

The Lake Chelan National Recreation Area in Washington State in 2012, showing patches of unburned or slightly burned vegetation within the outline of a 1994 wildfire. C. Alina Cansler

Trees that survive in a refugium also may help speed the recovery of the surrounding ecosystem. Their seeds float across the charred landscape, producing a new crop of plants.

For early studies of fire refugia, ecologists hiked through forests and grasslands, inspecting islands that withstood surrounding flames. Now researchers are scrutinizing fire refugia from space. With nearly 50 years of satellite data, they're starting to piece together the recent history of these sanctuaries.

After a fire wipes out a forest, fire refugia stand out as green jewels scattered across the blackened land. Depending on the forest, up to 25 percent of it may survive in refugia, Dr. Krawchuk estimated.

Sometimes a forest refugium survives a particular blaze thanks to luck. "We might have a change of wind, it cools down at night, and the fire might not grab that patch of forest," said Arjan Meddens, a fire ecologist at the University of Idaho and lead author of the BioScience review.

But when researchers look at satellite images from other years, they see that some refugia are different. "There are some places in the landscape that seem to avoid fire time and time again," said Dr. Krawchuk.

"The most interesting thing is why," she added. "What makes that green spot stay that way?"

There are probably many factors at work. In the Northern Hemisphere, the north sides of mountains favor refugia. The plants there get less sunlight that their south-facing counterparts. They often hold more water in their trunks and roots, and they grow in moister soil that can tamp down fires.

Fire refugia don't have to endure for centuries to be ecologically important. Even a fleeting shelter can be important for local biodiversity.

Grasslands may catch fire every year, and patches that survive one year typically burn the next. For butterflies that call grasslands home, these fleeting

fire refugium can be crucial to survival.

Firefighters at work on the Roosevelt Fire near Bondurant, Wyo., last month.
Ryan Dorgan/Jackson Hole News & Guide, via Associated Press

As long as some of them can find a safe place to hide from fire each year, the species will endure. If grasslands burned entirely to the ground every year, the butterflies would become extinct.

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In their review, Dr. Meddens, Dr. Krawchuck and their colleagues argue that short-lived refugia have a lot in common with ancient stands of old-growth forests.

“We tried to tie this all together and say, ‘It’s all the same idea,’” said Dr. Meddens. “We can start to think about these things in a more organized way.”

Today, fire refugia face many pressures, such as invasive species and outbreaks of pests. But in the future, climate change may pose a far bigger threat.

Global temperatures are rising. In many places, this has led to heat waves and droughts, which can turn plants into fuel. In years to come, refugia may become rarer as fires become more intense.

Ecologists still don’t know enough about fire refugia to come up with a broad strategy for preserving them. “That requires identifying where they are and why we think they’re important,” Dr. Krawchuk said.

If researchers can reach agreement on that, she said, they build an atlas of fire refugia from satellite images and ground-based studies. “That would be sort of the Holy Grail,” Dr. Krawchuk said.